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Merchandising Builds
Produce Sales

MARKETING ACTIVITIES



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Merchandising Builds Produce Sales

By W. A. Lee, William S. Hoofnagle, and Hugh M. Smith

Variety, visibility, larger pricing and packaging units, and cleanliness are useful merchandising principles. Actually these principles are just plain common sense. But when they are applied in merchandising experiments, the results are often rather startling.

During the past two years, research personnel of the Market Development Branch, Agricultural Marketing Service, USDA, and personnel of Pennsylvania State and Cornell universities conducted merchandising experiments in Pittsburgh (Pa.) supermarkets. The researchers wanted to test various methods for selling more fresh produce.

In one test they found that a combination display of bagged and bulk apples, priced in 5-pound units, increased apples sales 75 percent. Sales increased still further when the bagged apples were offered in varying weights of 2 to 6 pounds. The increased sales apparently resulted from the added variety. Some customers preferred to select apples from bulk displays, others preferred the convenience of bags. Maximum sales were achieved by satisfying both types of customers.



Variety, visibility, and a larger package size.

Variety Affects Sales of Individual Items

Variety is known to be an important factor affecting total store sales and sales within departments. The Pittsburgh experiments indicate that it also affects sales of individual produce items.

Similar results were obtained when washing was introduced into the merchandising of Pennsylvania potatoes. When only washed potatoes were offered, at a premium sufficient to cover extra costs, sales were about the same as for unwashed Pennsylvania potatoes. Sales increased over one-fourth when both washed and unwashed potatoes were offered. Again, some of the customers apparently liked the washing service while others did not particularly respond to it.

A combination display of medium- and large-size pears in bulk and in various size packages resulted in sales one-fourth larger than sales from a display of medium-size pears alone.

In mushroom experiments, increasing the variety of package sizes, particularly by offering packages larger than the usual pint box, also showed promise of increasing total mushroom sales.

Carrots moved more rapidly from the produce rack into the hands of consumers when 2-pound bags were offered along with 1-pound bags.

These results all point to the importance of variety in satisfying the different preferences of consumers. This principle can be applied to other products and marketing practices.

Visibility Sells Packaged Produce

Many customers apparently do not like "buying a pig in a poke." This is particularly true for fresh produce that varies in quality.

When only washed Pennsylvania potatoes in window paper bags were offered, sales were no greater than when only unwashed Pennsylvania potatoes were offered. Sales increased more than one-fourth when only washed potatoes were offered in 10-pound polyethylene bags. The improvement in appearance of the washed potatoes was much more evident in the film bags than in the window paper bags.

Despite a 3-cent premium, tomatoes offered in transparent plastic tubes sold more readily than tomatoes offered in cardboard tubes that covered up more of the tomatoes. The sales increase was not conclusive. But it did suggest the influence of visibility in selling products that vary in quality.

Mushroom sales were increased nearly one-third by introducing a new 1-pound package that gave customers a better look at the mushrooms.

Visibility builds sales only when it shows an attractive product. This was brought out in mushroom experiments in which extra handling contributed to browning that detracted from the appearance of the mushrooms.



Larger Pricing and Packaging Units

Previous surveys have indicated the tendency of customers to buy food in the units in which they are priced. For instance, if lettuce is priced at 2 heads for 38 cents, a shopper is more apt to buy the 2 heads than 1 or 3. This tendency, plus the apparently general belief in the "big economy size" and "quantity discounts," was used to increase sales in some experiments.

Apple sales increased over one-third when a combination display of 3-pound bags and bulk priced 3-pound units replaced a bulk display. When the package and pricing unit was increased to 5 pounds in the display the sales increased 60 percent over the bulk sales.

Lettuce sales were slightly larger from a bulk display with a 2-head price than from a bulk display with a single-head price. This difference, while not conclusive, points to the influence of larger pricing units on sales. A one-third increase in mushroom sales was at least partly the result of adding a larger package size.

Experiments indicated possibilities for increasing sales by the use of pricing units somewhat larger than those in current use. Many current pricing units result from trying to keep the total value under certain levels. Some of these levels are no higher today than they were during depression years, when incomes and price levels were much lower.

Cleanliness Builds Sales

Results of the potato experiments indicate considerable potential in building sales through the simple practice of washing off soil. Cleanliness may also be involved in the preference for bagged over bunch carrots. In an experiment on carrots, a combination display of 1-and 2-pound polyethylene bags sold 37 percent more carrots than a display of 1-pound bunches.

Cutting The Cost Of Split Packages

By Robert K. Bogardus

Wholesalers who accept orders for fruits and vegetables in amounts of less-than-full package quantities can reduce the cost of split-package service to their customers. They can do it by adjusting their sales policy or by using improved methods and equipment suggested by researchers from the Agricultural Marketing Service, U. S. Department of Agriculture.

Many wholesalers who provide this package-splitting service do so at no extra cost to their customers. But the job of making "little ones out of big ones" is time consuming and expensive. Recent AMS studies show that 1 man can assemble 14 tons of full packages of fruits and vegetables in the same time that it takes to make up and assemble 1 ton of split packages of various sizes. The labor cost alone for prepacking and handling split packages is 14 times greater per ton than that for handling full packages.

In most cases the volume of split items is large enough to keep one man fully occupied 8 hours a day. Labor expense is the major part of the cost of this service. But special containers, shrinkage from discarded damaged items, waste when the entire contents of a full package are not used, and the added handling during delivery all add to the cost.

Split-package sales are a necessary function of many wholesalers. They enable them to meet their competition. And, someone must service the small retail stores and institutions that cannot use full packages of the more perishable items. However, wholesalers can reduce the cost of package splitting.

One way is to adjust their sales policy. This involves:

- (1) Minimizing the number of commodities that will be sold in less-than-full package lots.
- (2) Standardizing units of sale for split items.

Wholesalers should split only packages of commodities that are highly perishable and move in small volume. Split-package sizes can be set up either by weight or by count. In either case a basic quantity should be used from which other order sizes can easily be made up.

For example, a package of 5 pounds of peppers is selected as a basic unit because that amount is frequently ordered. When an order for 10 pounds is received the order picker gets 2 of the 5-pound units. The basic unit is the common denominator for the larger orders. Standardization of package sizes will simplify the job of preparation of split items. It will contribute to a reduction in handling time.

Wholesalers also can reduce the high cost and time involved in preparing split packages by using these improved methods and equipment:

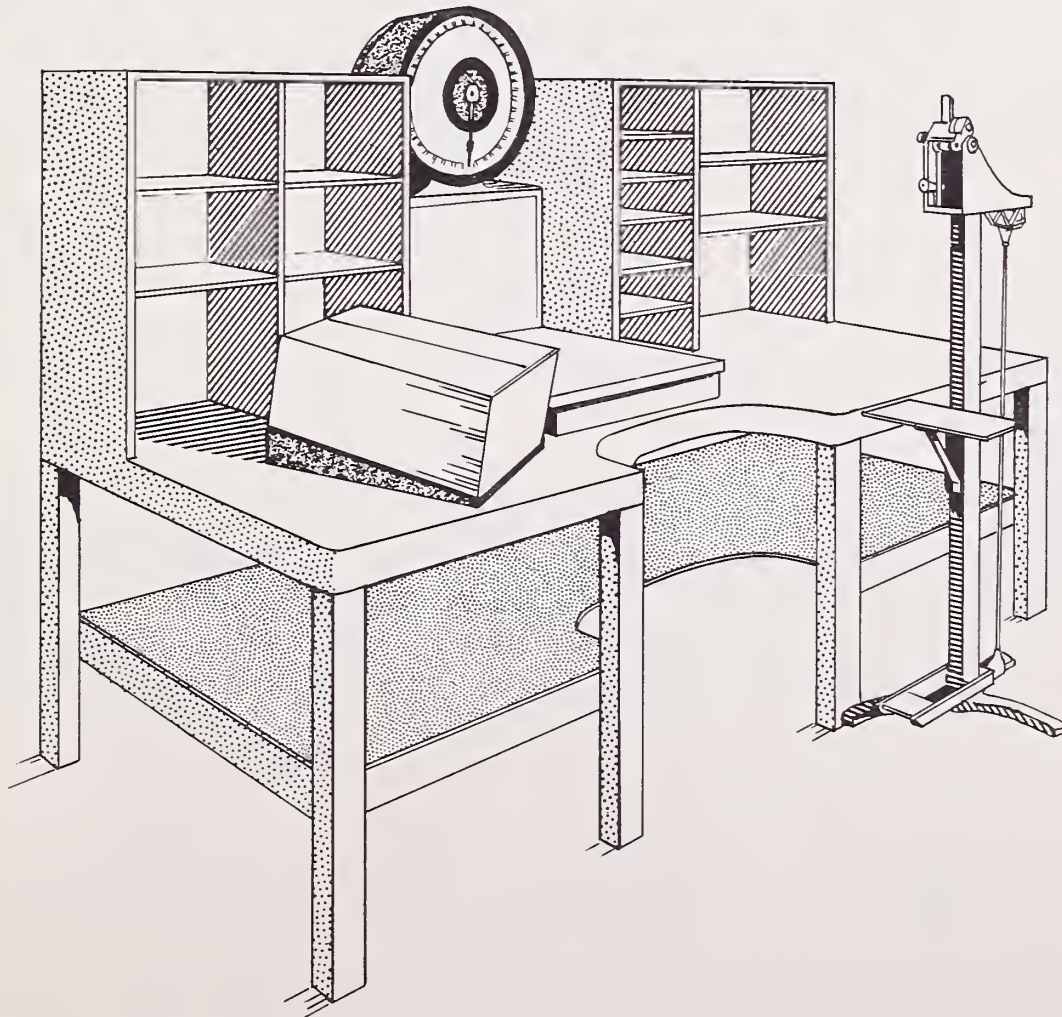
(1) Set up an efficient work center with racks for supplies, a scale, and a gummed-paper dispenser or stapler--all within easy reach.

(2) Locate the work center where it will not interfere with normal operations. Adequate space is necessary for a bench, for the temporary storage of split packages, and for opening the full packages.

(3) Assign the package-splitting job to one man. He can become proficient in making up the required number and sizes of packages. It also will be possible to hold him responsible for minimizing shrinkage losses.

(4) Make a "recap" of the number of packages that have to be made up. The "recap" is helpful in getting this job done in the least possible time. With experience will come ability to estimate well in advance of the time the trucks are loaded the number of packages that will be needed. The estimating job is simplified when the package sizes and commodities split are standardized. The "recap" can then be used to check the numbers of each size and commodity that have been prepared in advance. Items that are short can be made up quickly.

(5) Provide a compartmented rack for storing split packages by size and commodity. This rack can be built on a pallet, dead skid, or 4-wheel handtruck for easy moving to the assembly or order-picking area.



Here's an efficient work center for splitting packages. Notice that supply racks, a scale, and stapler are within easy reach.

Lamb And Mutton Consumption In U.S.

By Harry O. Doty, Jr.

Lamb and mutton are more unevenly distributed throughout the United State than most agricultural commodities, according to data for 1954 showing the distribution of lamb and mutton for consumption by regions and States. The data was obtained from a recent survey, conducted by the Agricultural Marketing Service, U. S. Department of Agriculture, of lamb and mutton shipments.

This study was designed to provide information to sheep and wool producers, meat packers, wholesale distributors, and retailers in planning improved merchandising, promotion, and advertising programs for lamb and mutton.

59 Percent to Middle Atlantic and Pacific Regions

In 1954, domestically produced lamb and mutton were shipped (or were otherwise available) for consumption primarily to the Middle Atlantic and Pacific regions. Together, these 2 regions took 59 percent of the total. Thirty-six percent of available lamb and mutton was distributed to the Middle Atlantic region; the Pacific region was second with 23.0 percent. The East North Central and New England regions followed with 14.6 and 11.8 percent, respectively.

The Northeast States, composed of the Middle Atlantic and New England regions, received almost 50 percent of the lamb and mutton shipped or locally produced and distributed during 1954. Lamb and mutton were distributed in relatively small amounts to the Southern West North Central, and Mountain States.

The quantity of lamb and mutton going to States in the same region varied widely. In some regions, the quantities going to one State largely accounted for the total lamb and mutton shipments to the region. For instance, California took 91 percent of the lamb going to the Pacific region. Similarly, the major portion distributed to New England and West South Central regions went to Massachusetts and Texas, respectively.

53 Percent to New York, California, and Massachusetts

Fifty-three percent of all lamb and mutton was shipped in 1954 to New York, California, and Massachusetts. Lamb and mutton shipments to New York and California were more than double shipments to any other State. Slightly less than 24 and 21 percent, respectively, of the total available supplies were shipped to these States. The third ranking State was Massachusetts with slightly over 8 percent of the total. Other

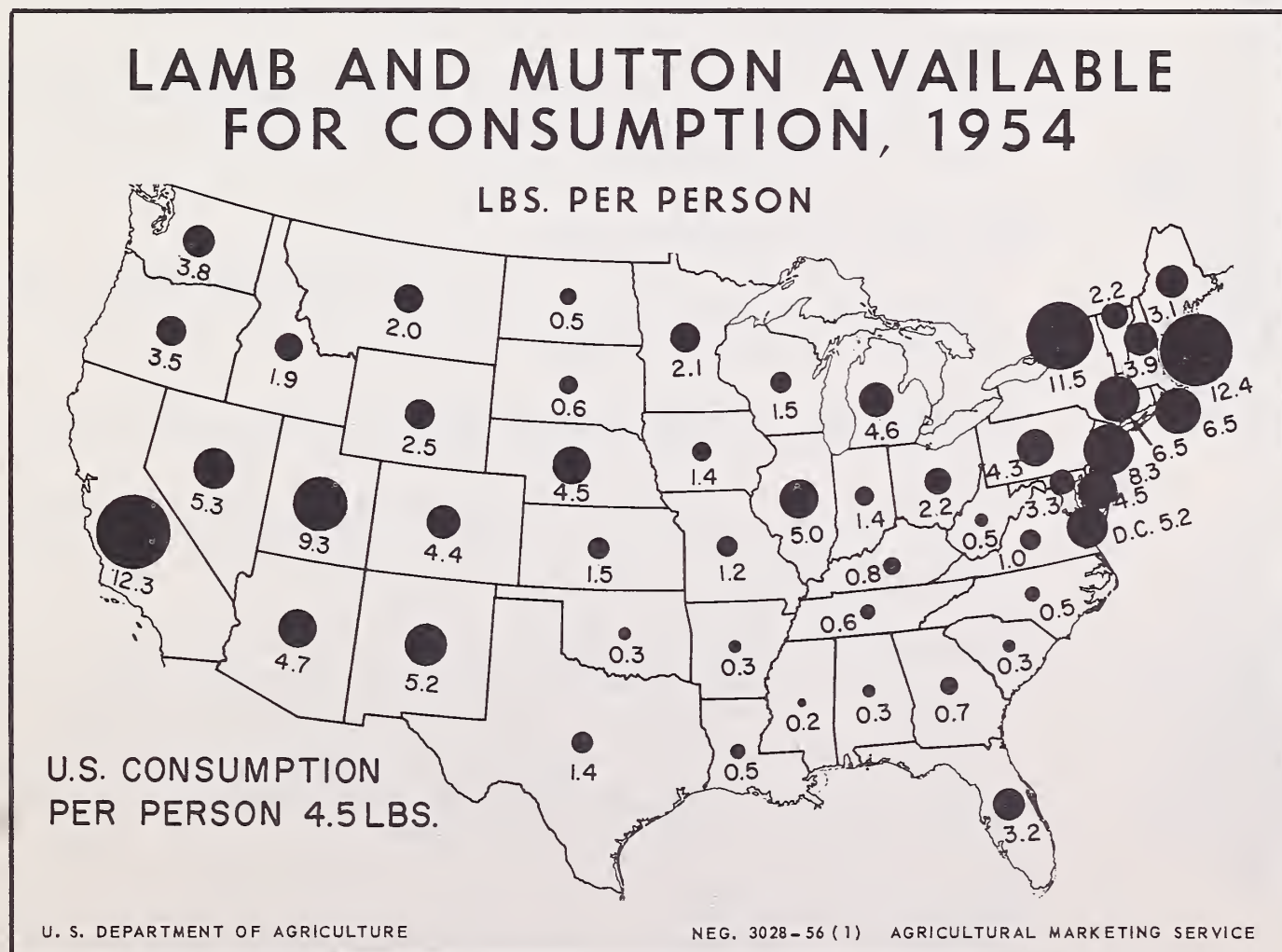
leading States were: Pennsylvania, 6.2 percent; Illinois, 6.2 percent; New Jersey, 5.9 percent; and Michigan 4.3 percent.

Pounds Per Person for Each State

On a per person basis, lamb and mutton available for consumption also varied widely among States. Consumption per person was by far the highest in Massachusetts and California with 12.4 and 12.3 pounds, respectively. Other States which had relatively high per person consumption were New York with 11.5 pounds, Utah with 9.3 pounds, New Jersey with 8.3 pounds, Rhode Island with 6.5 pounds, and Connecticut with 6.5 pounds. Only 5 other States--Nevada, New Mexico, Illinois, Arizona, and Michigan and the District of Columbia--had higher consumption per person than the United States average of 4.5 pounds.

In 1954, lamb and mutton furnished less than 3 percent of the 26 billion pounds of meat (not including poultry and fish) consumed in this country. The quantity of lamb and mutton eaten is less than one-tenth as great as the amount of either beef or pork. Consumption per person in 1954 was 4.5 pounds, down from 7.2 pounds in 1945--the largest in recent years.

Lamb and mutton available for consumption totaled 739,425,000 pounds dressed weight in 1954. Meat establishments under Federal inspection shipped 649,822,000 pounds; other commercial meat packers' production was estimated at 76,603,000 pounds; farm slaughter, 13,000,000 pounds.



HOMEMAKERS' Preferences for selected c



Users and Nonusers of Lamb

Almost 5 in 10 homemakers in the Cleveland area used lamb in the preceding year, according to results of a sample survey conducted in mid-1955. Approximately 1 in 6 bought lamb during the week preceding the interview. Among the nonusers about half had used it at some time in the past.



Frequency of Serving

Out of every 10 homemakers who used lamb in the last year, 3 served it 3 or more times a month; nearly 4 served it at least once a month; and 3 served it less than once a month.

Preferred Cuts

Chops and leg of lamb are the favorite cuts of an overwhelming majority of lamb users; 5 in 10 chose chops and 4 in 10 selected leg of lamb.



What Users Like About Lamb

More important items: its distinctive flavor, nutritive qualities, lean tender texture, ease of preparation, and variety it adds to meals.

Why Users Don't Serve Lamb as Often as They Would Like to

Almost half of the homemakers who used lamb said they would like to use it more often. The main reason they don't is the cost; a less important reason, some member of the household doesn't like it.

Relative Food Value of Lamb

A majority of lamb users believed the food value of lamb was equal to or greater than the food value of beef, veal, or pork; 1 in 10 felt that it was less nutritious than the other meats. The majority of nonusers, on the other hand, felt unable to make a comparison.

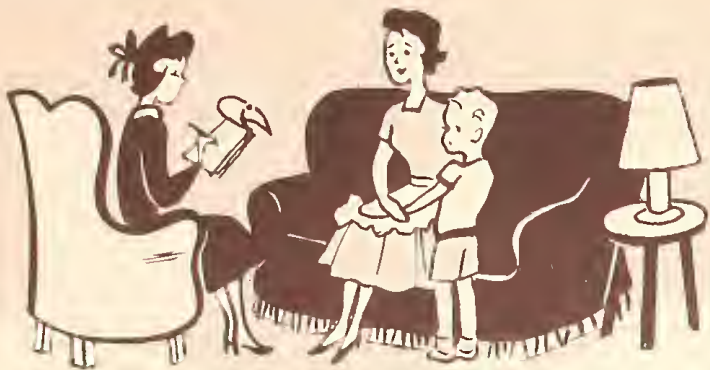


Seasonal Use of Lamb

About 3 lamb users in 10 use lamb more in the winter and spring than at other seasons of the year. For the most part

HOMEMAKERS' Preferences for selected cuts of LAMB

in Cleveland Ohio



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Seasonal Use of Lamb

About 3 lamb users in 10 use lamb more in the winter and spring than at other seasons of the year. For the most part

the reasons they gave for this seasonal use dealt with the superior quality of lamb during this season, its more general availability, and the inconvenience or discomfort of cooking during hot weather.

Characteristics of Users

Homemakers in the upper income groups, the better educated group, and in the group over 45 years of age are more likely to use lamb than those in lower income, education, or age groups. Those whose parents were born in the Northeastern or North Central States were also more likely to be lamb users than were respondents whose parents come from other parts of the country. Lamb users, both wives and husbands, are about twice as likely as nonusers to come from homes in which lamb had been served.

Availability

Eight users in 10 said that lamb was available the year round in the stores where they shop; only 1 in 10 had been unable to buy lamb more than 3 times during the year.

What Users Dislike About Lamb

While 3 in 10 users had no reasons for disliking lamb, 7 in 10 expressed one or more reasons for disliking it. These included economy, texture, flavor, odor, and preparation.

Why Nonusers Don't Use Lamb

Most frequently mentioned reasons: a dislike of the flavor, and eating habits developed in childhood. Less frequently mentioned reasons: a dislike by some member of the family, an offensive odor, and an unpleasant past experience.

Use of Lamb for Special Occasions

Only 1 lamb user in 10 made a point of serving lamb on special occasions such as Easter, New Year's Day, or Sunday. But 4 in 10 served it to guests during the year. Thus, lamb seems to be regarded not only as an everyday food, but a food also appropriate for a company dish.

Influence of Various Promotional Methods

The majority of the 786 housewives interviewed decide what meats they are going to buy before they go out to shop. Nevertheless, lamb displays in stores still appeared to be an important factor in the homemaker's decision to buy lamb. About half of the lamb users said they sometimes decide to buy lamb because of the displays.



Machine Pack Reduces Costs Of Field-Packing Lettuce

By Frank J. Smith and Robert V. Enochian

A shift from shed-packing lettuce to field packing in the Salinas-Watsonville District of California has resulted in substantial reductions in packing costs. Of the three field-packing methods commonly used in 1954--machine pack, ground pack, and trailer pack--the machine-pack method was found to have the lowest cost with average harvest conditions when used in conjunction with an hourly rate wage plan.

This was revealed in a recent study by agricultural economists of the Agricultural Marketing Service and the University of California.

Many factors can affect output rates and costs in packing from a particular field. These include the work method and equipment used; the wage plan; harvest density--the number of cartons harvested per acre in a given cutting; differences in skills among different workers and crews; the policy of a given firm with respect to quality of pack; the quality of lettuce harvested; ground conditions; and the number of times the field had been previously cut. Only the effects of work method, wage plan, and harvest density are specifically considered in this study. The results reflect the average industry experience with regard to the other factors.

Cost Comparisons

The costs shown on page 13 include the costs of harvesting and packing labor, supervision, and equipment used in the field operation and for transporting packed lettuce to the cooler. Packaging materials, precooling and carloading, and general administrative expenses are not considered. But the costs of these items would not vary significantly with the different field-packing methods studied.

With hourly rate crews at a harvest density of 200 cartons per acre (approximately the average for the industry during the period of the field studies), unit costs are lowest--21.3 cents per carton--with the machine-pack method. This is 3.3 cents less than the trailer-pack method and 2.3 cents less than the ground-pack method. A saving of 2.3 cents per carton amounts to \$14.72 per carload (640 cartons) and \$14,720 per season for firms shipping 1,000 cars annually, a volume exceeded by many shippers.

These cost relationships are approximately the same for a harvest density of 250 cartons per acre. However, with a harvest density of only 100 cartons per acre, unit costs are lowest with the ground-pack method--28.4 cents per carton. This is 0.2 cents per carton lower than the machine-pack method and 3.3 cents less than with the trailer pack.

THE EFFECT OF METHOD OF FIELD PACKING AND HARVEST DENSITY ON
COSTS WITH THE HOURLY-RATE WAGE PLAN



Harvest density, cartons per acre	Output, cartons per packer hour	Labor, Equip- ment and supervision costs -- Cents per carton
---	---	--

GROUND PACK METHOD

100	17.7	28.4
150	19.4	25.8
200	21.2	23.6
250	23.2	21.9



MACHINE PACK

100	24.5	28.6
150	29.5	23.7
200	32.8	21.3
250	35.3	19.9



TRAILER PACK

100	26.0	31.7
150	30.8	26.7
200	33.5	24.6
250	35.3	23.4

With the piece-rate wage plan, there is relatively little variation in unit costs due to variations in harvest density and packing method. At a harvest density of 200 cartons per acre, costs with the ground-, machine-, and trailer-pack methods are 24.8, 24.5, and 25.8 cents per carton, respectively. Compared with the hourly rate wage plan, costs with the piece rate are higher with all methods, except with harvest densities lower than about 100 cartons per acre.

For the winter lettuce districts of the Imperial Valley of California and Yuma and Phoenix, Arizona, the costs would be somewhat different. An operating season of 720 hours in the winter areas tends to make unit fixed costs of equipment high relative to the Salinas-Watsonville district, where the season is approximately 1,280 hours, while lower wage rates with hourly rate crews tend to make harvesting and packing labor costs lower. With piece rate crews, harvesting and packing labor costs are the same in both areas. When the adjustments for length of season and wage differences are made, costs per carton for hourly rate crews at a harvest density of 200 cartons per acre range from 1.0 to 2.5 cents less than in the Salinas-Watsonville area. On the other hand, costs with the piece-rate crews range from 0.3 cent to 1.2 cents per carton more than in the Salinas-Watsonville district.

Operations Performed

The operations performed with the 3 methods of field packing are basically the same. They include carton assembly, carton distribution, cutting and trimming, pickup, packing, carton closing, and loading. The 3 methods differ primarily in the type of equipment, number of men used in each job category, and the sequence and place of performing these jobs.

With the ground-pack method, all of the jobs except carton assembly are performed on the ground. Crew size varies considerably with this method, and the costs given in this report are based on a crew size commonly observed during this study. With the trailer and machine methods, only the job of cutting, trimming, and pickup are performed on the ground. The primary differences between the machine- and trailer-pack methods are that the former has a much larger crew and the packing unit is self-propelled while, with the latter, the packing unit is pulled by a truck which also received the packed cartons.

Production Standards

Production standards typical of operation under relatively efficient conditions were derived from the estimates of net labor requirements for each job by adding allowances for personal time, unavoidable delay, and turn-around time at the end of each harvest strip. The job with the lowest output rate per hour with a given crew organization--the bottleneck job--was taken on the production standard for the entire crew. Separate production standards were developed for work under piece-rate and hourly rate wage plans.

Total costs per field hour were calculated on the basis of labor and equipment requirements derived from the production standards and the appropriate cost rates.

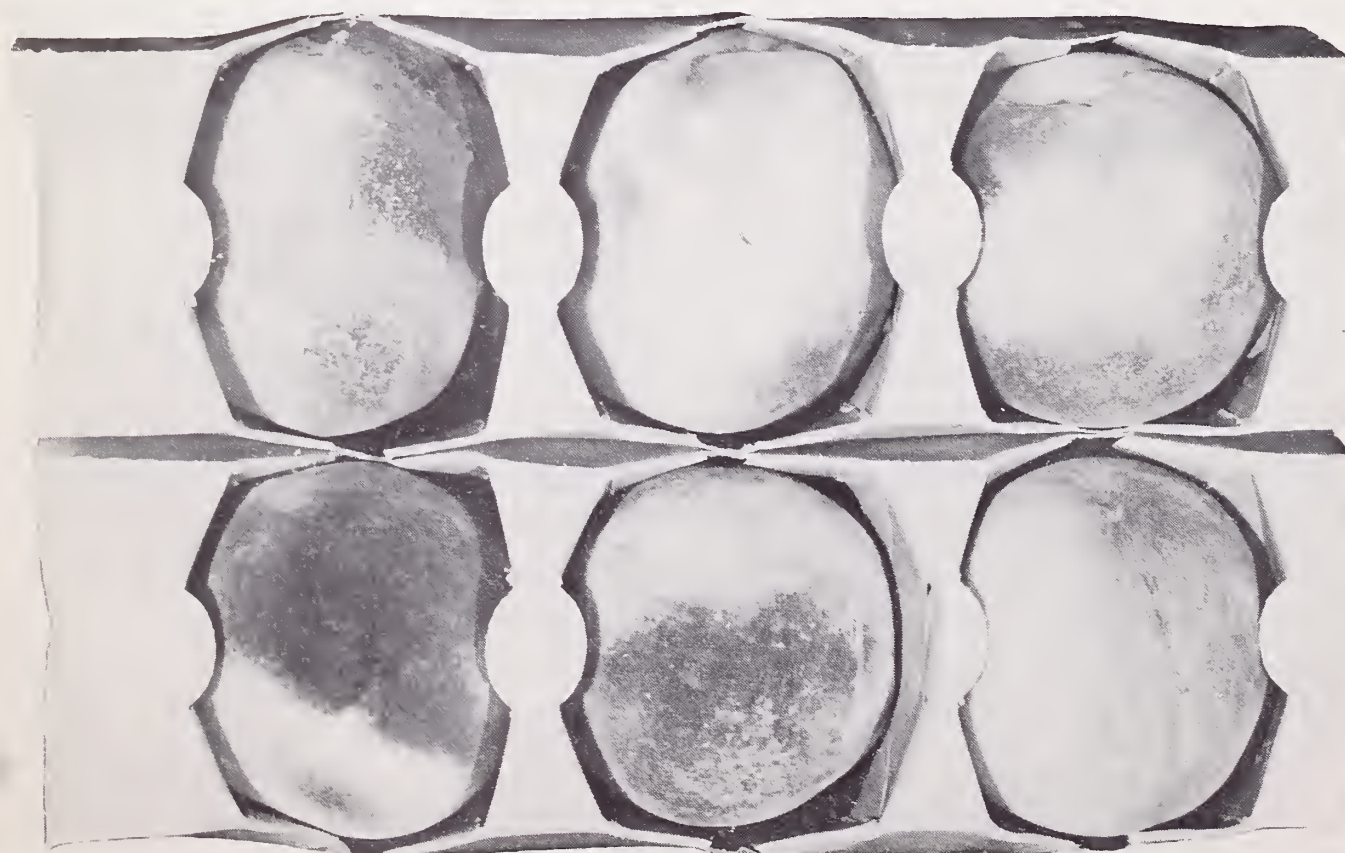
Packaging Tree-Ripened Peaches

By Homer C. Evans and Philip W. Hale

Consumers prefer tree-ripened peaches and will pay premium prices to get them. Growers would like to package and ship these peaches. This would increase their total sales volume and returns by offering growers another outlet for tree-ripened peaches. Present practice is to sell this soft and ripe fruit at relatively lower prices to local people for home canning, to nearby markets, and to processors.

But, so far, growers have been unable to pack and ship peaches in advanced stages of maturity profitably--even at premium prices. Total container and labor costs for a ripe pack less the premium price obtained from the sale of the ripe peaches is still greater than the cost of packing hard mature peaches in comparable size containers.

However, researchers of the Agricultural Marketing Service have made some progress in developing better packages and better methods for prepacking that may eventually lead to reduced packing costs for ripe peaches. During the 1955 peach season, researchers of AMS and the West Virginia Experiment Station conducted a packing experiment that almost succeeded in marketing ripe peaches. This involved using a new-type nest-like carton for packing ripe peaches. Four growers cooperated in the study.



This new experimental consumer carton held 6 large tree-ripened peaches in individual cells. Other cartons were designed to hold 8 or 10 smaller peaches.

This new carton holds 6, 8, or 10 peaches, depending on the size of the peach. The fruit is placed in individual cells, similar to those in egg cartons, that offer considerable protection against bruising during shipment. Jutting over the top of each cell are 2 tabs that prevent the fruit from falling out if the carton is tipped upside down. Perforated seams on the bottom of the carton allow the peaches to be removed easily. A hand-hold helps housewives carry the carton.

The cartons were treated so they could be immersed in a watercooling bath without disintegrating. Other studies have shown that hydrocooling reduces the internal temperature of peaches, keeping them fresh longer. The filled cartons are packed in 16-carton wirebound master shipping crates.

Experimental Cartons Shipped to 16 Markets

These crates and 3/4-bushel baskets were shipped to 16 markets as far west as Chicago, northward to Boston, and as far south as Miami. Tree-ripened peaches equivalent to 5 carloads of hard mature peaches were shipped from 1 packing shed in West Virginia, 1 in Maryland, and 2 in Pennsylvania.

The cost and salability of consumer packages in master containers were compared with the commonly used 3/4-bushel basket; each held approximately 38 to 40 $\frac{1}{2}$ pounds of peaches. Twenty shipments of tree-ripened prepackaged peaches and 20 companion shipments of hard mature peaches brought average wholesale prices of \$2.85 and \$2.33 respectively; a difference of 52 cents in favor of the prepackaged peaches.

However, the container materials cost 87 cents a crate for the ripe peach pack; 46 cents higher than the cost for the 3/4-bushel basket. And the labor cost for the ripe peach pack was 19 cents or 13.4 cents more than for the basket.

Returns from Hard Mature Peaches Slightly Greater

Thus, the combined average labor and container cost was 59.4 cents more for the finished pack of ripe peaches. Deducting the 52-cent premium obtained from the sale of the ripe peaches, this meant that the growers' returns from hard mature peaches were slightly greater.

Due to the wide variation from day to day of labor efficiency, particularly for the new containers, labor costs were obtained only when the packing line appeared to be operating most efficiently. A hypothetical hourly wage of 75 cents was used in comparing labor costs.

Machinery used for sizing the hard mature peaches bruised the tree-ripened peaches. As a result they had to be sized slowly and not too accurately by eye. This increased the packing cost.

None of the growers wanted to interfere with regular production lines of hard mature peaches. Therefore, the packing lines set up for the tree-ripened run were cramped for space, without adequate facilities, and of such design that a steady flow was almost impossible.



This is the master container in which 16 consumer cartons of tree-ripened peaches were shipped in 1955. The cartons are packed on end, 2 across, and 8 along the length of the master container.

The packers' lack of experience with the new container also slowed the operation. In addition, tree-ripened peaches frequently were not delivered from the orchards in sufficient volume to keep the packing crew working at the peak of its restricted capacity. In one case, peaches brought to the shed were too big to fit in even the largest size individual carton.

Consumers Prefer Tree-Ripened Peaches

In 1954, the West Virginia Experiment Station showed that consumers prefer tree-ripened peaches to the hard mature peaches found in the regular commercial pack. When consumers were offered matched lots of tree-ripened and hard mature peaches at the same price, 85 percent of their purchases were from the tree-ripened lots.

Offering either tree-ripened or matched lots of tree-ripened and hard mature peaches at the same price more than doubled sales when only hard mature peaches were offered. Even when hard mature peaches were priced $9\frac{1}{2}$ cents a pound and tree-ripened peaches $15\frac{1}{2}$ cents a pound, 57 percent of the sales were from the tree-ripened lots. Numerous other studies also show that consumers prefer ripe peaches.

Research to develop satisfactory methods of packaging ripe peaches will be continued next season. Consumers want riper peaches and peach growers will pack them if a way can be found to do it profitably.

Ground Condensers

Conserve Water

By Joseph F. Herrick, Jr.

Refrigeration systems of the future may be able to conserve water and reduce power requirements by dissipating the heat from the systems through ground condensers rather than through water-cooled condensers.

Ground condensers have been employed only in a limited number of installations. However, G. F. Sainsbury of the Agricultural Marketing Service has been testing the feasibility of using a grid of tubing underground to dispose of heat from a refrigeration system directly to the ground.

The performance of a ground condenser installed as part of the cooling system of a small apple storage in North Central Washington was observed by agricultural engineer Sainsbury for one season.

This condenser consists of fifteen 100-foot lengths of soft copper tubing. The tubing is laid in a bed approximately 16 feet wide and 100 feet long. It is covered with earth varying in depth from 15 to 30 inches.

May Offer Practical Solution to Water Conservation Problems

Research indicates that ground condensers may offer a practical solution to water conservation problems if sufficient natural precipitation or irrigation water is available to keep the ground from becoming so dry that it loses much of its thermal conductivity.

Ground condensers also offer the possibility of reducing power requirements for a given size refrigeration system where the supply of water is limited.

Comparisons of the operating economy of this system with that of a conventional water-cooled installation having a limited water supply showed the ground condenser system used less power.

Observations were made of ground temperatures at different levels and locations. Pipe temperatures were taken. Thermocouples were used to measure these temperatures.

Most of the temperatures were read intermittently from a hand balanced semiprecision-type potentiometer. However, during one 6-day period the thermocouples were connected to a multipoint strip-chart recording potentiometer for a continuous recording of temperatures.

For the most part, temperature differences between various locations stayed fairly constant over the season despite a wide variation in outside temperatures. Ground-surface temperatures and ground temperatures at lower levels did not follow this pattern. Air temperatures and the amount of solar radiation affected their relationship.

Dry Ground Affects Condenser Efficiency

When the ground dried, the efficiency of the condenser fell. After irrigating, however, the condenser again functioned normally. To operate properly the condenser needs moist soil. Dry soil has a lower thermal conductivity.

Where water to moisten the soil is lacking much of the time, the use of a ground condenser appears questionable.

Low Outside Temperatures a Hazard

Low outside temperatures represent a hazard to proper condenser operation. Too low a ground temperature would reduce the condensing pressure to the point where liquid refrigerant would not pass through to the evaporator. The record for the past season shows that this condition was not approached.

However, this past winter was not particularly severe in the test area. The record obtained cannot be considered as positive evidence that such a condition might not arise in the future.



Ground condenser after fabrication and before covering.

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